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ABSTRACT

In the fall semester of 1972-73, two general biology classes were offered and taught by the same teacher. One class received lecture material in the traditional manner, attending three one-hour lectures each week. The 82 students in this class were designated the control group. The 52 students in the other class, known as the experimental group, received lecture material by working independently at a learning center, using cassette lecture tapes and other audiotutorial materials and equipment. This group also attended a discussion session with the instructor once each week, the session being used for informal discussions only and for administering examinations. Test scores, final grades, and attrition in the control and experimental groups were compared at the end of the semester using statistical techniques. Results of the study showed that: (1) both methods of instruction were equally successful with respect to test scores and final grades; (2) attrition rate was high in both classes--experimental 38 percent and control 31 percent; (3) teacher performance was rated slightly higher by the audiotutorial group; and (4) teacher performance improved slightly with the new method of instruction. Tables provide the study data. The appendix is a copy of the Student Evaluation of Teachers form. (DB)

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A COMPARISON OF GRADES ACHIEVED, ATTRITION RATES, AND TEACHER EVALUATION IN A TRADITIONAL GENERAL BIOLOGY COURSE VERSUS A NON-TRADITIONAL, AUDIO-TUTORIAL BIOLOGY COURSE

APPLIED EDUCATIONAL RESEARCH AND EVALUATION

by

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TITLE OF PRACTICUM

A comparison of grades acheived, attrition rates, and teacher evaluation in a traditional general biology course versus a non-traditional, audio-tutorial biology course.

STATEMENT OF PROBLEM

In recent years the enrollment in the general biology course for non-majors has increased significantly. One side effect of this growth has been less personalized instruction to students with varying degrees of academic ability. This may affect the grades achieved by some students, and it is believed to have an influence upon the attrition rates in these classes. A large class makes it more difficult for direct teacher-student interaction, and this may influence the evaluation of teachers by students.

HYPOTHESIS

There is a significant difference in grades acheived in traditional versus non-traditional, audio-tutorial biology courses at Pasadena City College.

There is a significant difference in attrition rates in traditional versus non-traditional, audio-tutorial biology courses at Pasadena City College.

There is a significant difference in student evaluation of teaching in traditional versus non-traditional, audio-tutorial biology courses at Pasadena City College.

BACKGROUND AND SIGNIFICANCE OF STUDY

Due to changes in course requirements for graduation and the increase in student enrollment at Pasadena City College, class sizes in general biology have steadily increased. Each large class of approximately one hundred students saves the school the equivalent of two additional teacher salaries. Therefore, large lecture classes in general biology have been promoted and encouraged by the administration for the last eight years.

One of the major complaints of the seven hundred new biology students each semester is that they find themselves in large anonymous classes and are expected to perform well under these circumstances. The Life Science staff recognizes this as a valid complaint and only recently has made attempts to solve this problem. In 1971, the general biology staff at Pasadena City College initiated a pilot program in audio-tutorial instruction in general biology (a course for non-science majors). At that time, approximately one-third of the course was presented in audio-tutorial modules using the latest audio-visual technology available. The success achieved in this pilot program involving only a segment of the general biology course provided the stimulus for the possibility of modifying the entire general biology course into audio-tutorial modules.

These modules were patterned after S. N. Postlethwait's audio-taped presentations in freshman botany as taught at Purdue University.[1] The modules developed at Pasadena City College incorporated objectives, audio tapes, printed study guides, and other visual aids. These materials were to be used independently so each student could proceed at his own rate, and at any time repeat course material when it was necessary. These individualized instructional modules were designed to accommodate all general biology students with a wide and diversified range of experiences and competencies related to this science.

Dr. S. N. Postlethwait at Purdue University pioneered audio-tutorial instruction in the life sciences during the 1960's.[9] After more than a decade of experimentation and experiences with audio-tutorial modules, it would appear that everyone benefits in this type of instruction.

1. Student Benefits: Total involvement in the learning process, self-paced study, opportunity to develop sense of responsibility for own learning.

2. Teacher Benefits: Convenience in updating teaching material, ease in focusing on student deficiencies, reduction of routine aspects of instruction.

3. Institution Benefits: Modules are exportable from one campus to another, so many can benefit from modules produced at any one institution. In team-taught courses the module provides a mechanism for dividing the responsibilities of course preparation among members of the team.[2] The development of biology audio-tutorial modules at Pasadena City College has proceeded slowly and carefully. The Life Science staff has benefited from the experiences at Southwestern College and Golden West College in Southern California.[5]

The traditional lecture format has been reexamined at Pasadena City College and alternative forms of instruction are being developed. The Life Science staff has proceeded cautiously in this development recognizing that ineffective lectures could very easily become ineffective audio-tutorial instruction.[3] In summary, the Life Science staff hopes by individualized instruction in general biology that grades will be improved, attrition rates will decrease, and teacher effectiveness will improve.

DEFINITION OF TERMS

Attrition Rate:	Percentage of Students withdrawing from a college course during a semester.
Audio-Tutorial Instruction:	A method of instruction where various combinations of audio-visual media are used to present subject matter to students working independently.
Module:	A self-contained and independent unit of instruction.
Non-Major:	Students with academic majors outside of the Life Sciences.
Non-Traditional Biology Course:	A student-oriented course that consists of a discussion session, independent study, and a laboratory each week.
Pilot Program:	An experimental instructional program.
Self-Paced Study:	A method of learning where each student progresses at his own rate.
Team-Taught Course:	A single college course taught by several cooperating staff members.
Traditional Biology Course:	A teacher-oriented course that consists of three lectures and a laboratory each week.

LIMITATIONS OF STUDY

This study is limited to a comparison of only two classes: one traditional, general biology class versus one non-traditional, audio-tutorial, general biology class. These classes are not true random samples of the school population.

Only final letter grades and five examination scores will be compared in the two classes.

No attempt will be made to determine what the reasons are for withdrawal from the classes.

No attempt will be made to correlate science and mathematical background with grades achieved in general biology.

No analysis will be made of the differences in student environmental background.

The evaluation of the teacher's effectiveness will be determined only through the use of a student questionnaire.

Implications gained through information attained from this study may only have value to the Life Science staff at Pasadena City College.

BASIC ASSUMPTIONS

The basic assumptions concerning this study are as follows:

The two classes, one traditional lecture class and one non-traditional, audio-tutorial class, studied are reasonably homogeneous. (See Table 3)

The same teacher for both classes will provide equal learning opportunities for all students.

The two classes involved in this study each have a normal distribution of intelligence.

The students in both classes have equal opportunities to achieve certain grades.

PROCEDURES FOR COLLECTING DATA

In the fall semester of 1972-73, two general biology classes were offered and taught by the same teacher, Thomas J. Belzer. One class received lecture material in the traditional manner by attending three one-hour lectures each week. The eighty-two students in this class were known as the control group. Fifty-two students in the other class were known as the experimental group. They received lecture material by working independently at a learning center using cassette lecture tapes and other audio-tutorial materials and equipment. This group also attended a discussion session with the instructor once a week. This one-hour session was used for informal discussions only--not lectures--and for administering examinations.

Test scores, final grades, and attrition in the control and experimental groups were compared at the end of the semester.

Teacher-evaluation forms were completed by students in the control and experimental groups at the end of the semester. (Appendix 1)

PROCEDURES FOR TREATING DATA

1. Compare the distribution of final grades in the control and experimental groups. Significant differences in grades will be determined by chi-square.

2. The $\bar{z}$-Test will be used to determine the significant difference between the mean scores of five examinations.

3. Chi-square will be used to determine significant differences in final grades and attrition rates in the two groups.

4. A frequency polygon will be used to provide a greater analysis of teacher performance between the groups.

DATA RESULTING FROM STUDY

TABLE 1

COMPOSITION OF CONTROL AND EXPERIMENTAL CLASSES

	Experimental		Control	
	Number	Percent	Number	Percent
Freshman	36	69.2	50	60.9
Sophomore	16	30.8	32	39.1
Males	30	57.7	48	58.5
Females	22	42.3	34	41.5

TABLE 2

ANALYSIS OF PRETEST SCORES IN CONTROL AND EXPERIMENTAL CLASSES

Test	Class	Number	Mean	Standard Deviation	$\bar{z}$-Test
Pretest	Experimental	46	8.45	2.00	1.0425
	Control	77	8.84	2.16	

TABLE 3

ANALYSIS OF TEST SCORES IN CONTROL AND EXPERIMENTAL CLASSES

Test	Class	n	$\bar{x}$	s	$\bar{z}$-Test
1	Experimental	49	56.08	12.64	2.2800
	Control	75	61.21	11.38	
2	Experimental	39	45.43	9.14	0.8306
	Control	71	46.95	9.08	
3	Experimental	36	47.02	10.95	0.4886
	Control	67	45.94	9.82	
4	Experimental	32	53.18	10.92	0.3755
	Control	62	52.32	9.53	
5	Experimental	32	101.64	16.22	0.8927
	Control	55	98.61	13.61	

TABLE 4

CALCULATION OF CHI SQUARE FOR ATTRITION COMPARISONS

Classes	F_O Observed Frequencies	F_E Expected Frequencies	$F_O - F_E$	$(F_O - F_E)^2$	$\frac{(F_O - F_E)^2}{F_E}$
Experimental Withdrew	20	17.46	2.54	6.45	.370
Experimental Persisted	32	34.54	-2.54	6.45	.187
Control Withdrew	25	27.54	-2.54	6.45	.234
Control Persisted	57	54.46	2.54	6.45	.118
				$X^2 =$	.909

TABLE 5

FINAL LETTER GRADE FREQUENCY

Class	Number	A	B	C	D	F	W
Experimental	52	3	10	13	4	2	20
Percent		6%	19%	25%	8%	4%	38%
Control	82	3	15	32	7	-	25
Percent		3%	19%	38%	9%	0%	31%

TABLE 6

CALCULATION OF CHI SQUARE FOR A AND B GRADE COMPARISONS

Class	Observed Frequencies	Expected Frequencies	F_O-F_E	$(F_O-F_E)^2$	$\frac{(F_O-F_E)^2}{F_E}$
Experimental (A & B)	13	10.68	2.32	5.38	0.50
Control (A & B)	18	20.32	-2.32	5.38	$\frac{0.27}{0.77}$
				$X^2=$	

TABLE 7

CALCULATION OF CHI SQUARE FOR C AND D GRADE COMPARISONS

Class	Observed Frequencies	Expected Frequencies	F_O-F_E	$(F_O-F_E)^2$	$\frac{(F_O-F_E)^2}{F_E}$
Experimental (C & D)	17	19.32	-2.32	5.38	0.14
Control (C & D)	39	36.68	2.32	5.38	$\frac{0.27}{0.41}$
				$X^2=$	

PERCENT OF ATTRITION BETWEEN EXAMINATIONS

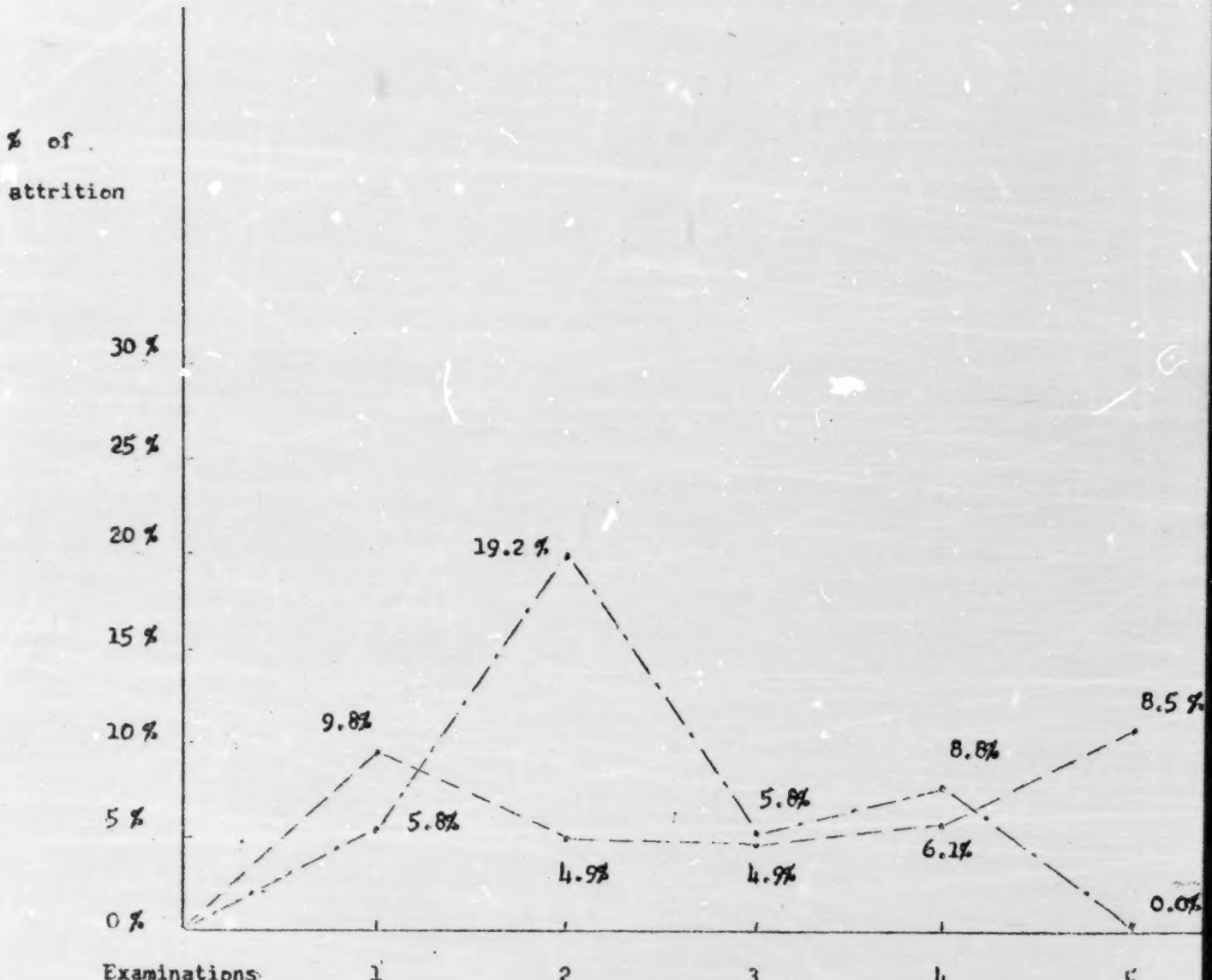

Fig. 1

SUMMARY EVALUATION OF TEACHING PERFORMANCE

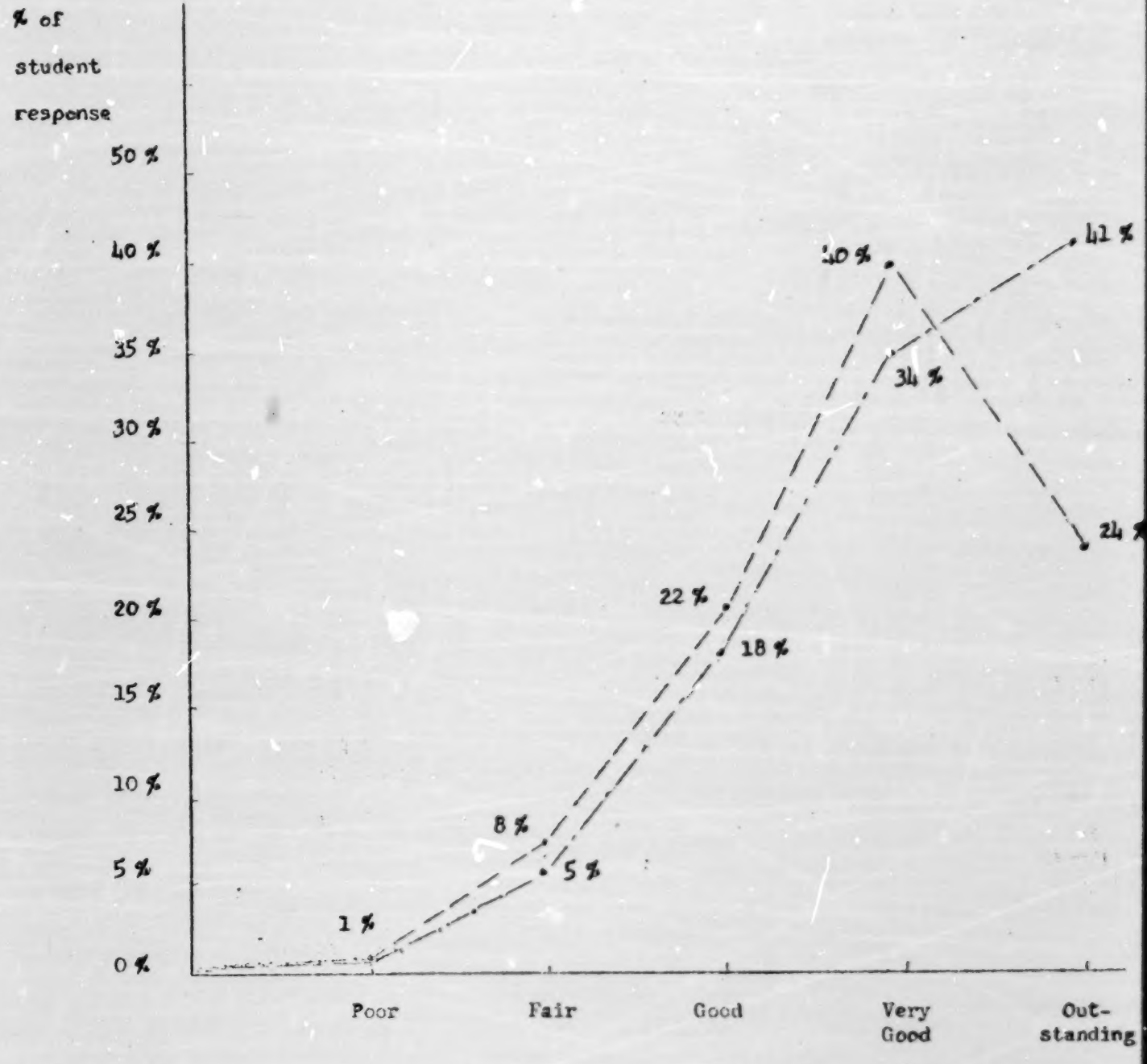

Fig. 2

SIGNIFICANCE OF THE DATA

In comparing the make-up of the two classes, it was found that there were no significant differences in class composition according to grade level or sex-ratio. (See Table 1) A pretest of twenty questions was administered to both classes during the first week of the semester. This examination covered factual material that is normally taught in a beginning biology course during the first or second year of college. There was no significant difference in the pretest scores of the experimental and control classes. (See Table 2) An analysis of this data indicates that both classes are reasonably homogeneous in regards to grade level, sex-ratio and biological background.

In the first two examinations given the control group averaged higher test scores. In the last three examinations given the experimental class averaged higher test scores, but in no case were the differences statistically significant ($\bar{z} < 2.58$ for α = .01 lever of significance). Therefore, the null hypothesis is supported since there are no significant statistical differences between any of the five examination test scores given to both classes during the semester.

Chi-square was used to determine if there was any significant difference in the over-all attrition rates between the experimental and control classes. (See Table 4) Since the calculated value of chi-square (X^2=.909, 1 degree of freedom) does not exceed the critical value of chi-square ($X^2 < 3.841$ for α = .05 dividend of significance), the null hypothesis is supported.

In the process of comparing semester attrition rates it was determined that the number of students withdrawing from the course between the first and second examinations in the experimental group was 19.2%. The percentage of attrition in the control group during the same period was 4.9%. (See Figure 1)

The only other interval period where attrition rates were not very close was between the fourth and fifth examinations. While the over-all attrition rate between the two classes was similar, it seems significant that over one-half of the total number of students withdrawing in the experimental class did so before the second examination.

Chi-square was used to determine if there was significant differences in the distribution of final letter grades between the two classes. A and B letter grades were grouped together, and C and D letter grades were grouped together for comparison purposes. (See Tables 5 and 6) The calculated values of X^2 for A and B grades comparison was not statistically significant (X^2=.769, 1 degree of freedom). Therefore, the null hypothesis is supported. The calculated value of X^2 for C and D grades was also not statistically significant (X^2=.419, 1 degree of freedom). The X^2 for A and B grades and C and D grades does not exceed the critical value of chi-square ($X^2 < 3.841$ for α=.05). Therefore, the null hypothesis is supported.

The evaluation of teacher performance in sixteen categories by both classes was very similar. It should be noted, however, that a greater percentage of the experimental class than the control group rated the over-all teacher performance "outstanding". This is an interesting outcome since the experimental class saw the teacher only once a week for discussions, whereas the control group met three times a week for conventional lectures.

DISCUSSION AND CONCLUSIONS

1. The audio-tutorial method of instruction and the conventional lecture method of instruction were equally successful with respect to test scores and final grades. The audio-tutorial method produced a greater percentage of A's and B's (25% to 21%) and a higher percentage of F's and W's (42% to 31%). Although the differences in letter grades are not significant, there is some indication that the audio-tutorial class showed extremes of success and failure.

2. Attrition rate was high in both classes (experimental 38% - control 31%). Students withdrew from the conventional class at about the same rate during the whole semester. In the audio-tutorial class 65% of the attrition occurred before the second examination. Perhaps the shock of a new instructional technique was a contributing factor in the high rate of attrition. After these early withdrawals in the audio-tutorial class, test scores improved and the attrition rate decreased significantly.

3. The slightly higher rating of teacher performance by the audio-tutorial group may have been due to the smallness of the class or the belief that this was a "special" group. This class may have identified more positively with the teacher because instruction was more informal, and discussion sessions replaced lectures.

4. While the experimental audio-tutorial method of instruction did not produce significantly better test results, better grades or reduced attrition, it is interesting that the results were not significantly negative either. There is some indication that teacher performance improved slightly with the new method of instruction. Even if grades cannot be improved or attrition reduced with the audio-tutorial method, it may have its greatest value in providing a stimulus for the improvement of instruction.

SUMMARY

(Thomas J. Belzer)

It should be emphasized that the materials developed and the methods used in the audio-tutorial, experimental class were experimental efforts. The imperfections became obvious only after students reacted to various combinations of audio-tutorial media. Another factor to consider was that the students worked independently in a temporary audio-tutorial learning center that was in its first year of operation. There were many problems with equipment and materials that students had to overcome in order to complete the audio-tutorial biology course.

It is interesting, however, that even with these problems the grades of the experimental class were not adversely affected. It seems reasonable to expect an improvement in grades and a reduction in attrition rate after the audio-tutorial methods, materials, and facilities improve.

As a direct result of this study the following recommendations are made:

(1) Continue to explore new and better ways of presenting biological concepts to non-science majors.

(2) Investigate the possibility of modifying present student evaluation procedures. A more flexible and varied testing program would allow for a more realistic self-paced course.

(3) Search for ways to personalize instruction more. Audio-tutorial methods and materials used alone tend to impersonalize the learning environment. Periodic small group sessions or individual conferences may be one solution to this problem.

(4) Provide alternative instructional programs in biology for different types of students. Possibly through early testing students could be programmed into a biology program that would have the most learning potential for them. Some students prefer a highly structured course, and others may perform better in an audio-tutorial or some other non-traditional program.

SUMMARY

(Michael R. Conti)

As a result of this study comparing conventional methods of instruction versus audio-tutorial methods of instruction, there may be opportunities for the application of similar audio-tutorial methods in human anatomy and physiology courses.

Students in these courses have vocational goals in physical therapy, occupational therapy, nursing, physical education, and photography and have a wide range of scholastic aptitudes. A self-paced, individualized course would help both students and teachers. The study of histology, microscopy, dissection procedures, and identification of muscles all require varying time periods to present and comprehend.

One obvious advantage of the audio-tutorial method of instruction would be an increase of student-teacher contact hours on a less formal basis. This would allow a greater opportunity for the teacher to work closely with individuals in identifying learning problems. Another advantage in audio-tutorial program for anatomy and physiology courses is in its basic flexibility. The individualized learning modules can be modified continuously for different types of students.

A disadvantage in audio-tutorial instruction may be in its basic unstructured design. Most students have not experienced this before and must be given careful orientation about the audio-tutorial methodology.

PASADENA CITY COLLEGE

Appendix 1

STUDENT EVALUATION OF TEACHE

COURSE: _____

PLEASE RATE THE PERFORMANCE OF THE TEACHER BY PLACING A MARK IN THE APPROPRIATE RECTANGLE. USE A NO 2 PENCIL ONLY. ERASE COMPLETELY ANY CHANGED ANSWERS.

	POOR	FAIR	GOOD	VERY GOOD	OUTSTANDING	DOES NOT APPLY
1. Clearly identifies the objectives of the course.						
2. Teaches in accordance with these objectives.						
3. Gives clear explanations.						
4. Conducts interesting class sessions which are helpful in developing competence.						
5. Encourages student questions and inquiry.						
6. Emphasizes the important aspects of the course in examinations and other means of evaluation.						
7. Provides ample opportunity for students to demonstrate their competence.						
8. Makes the results of tests and other means of evaluation readily available.						
9. Uses a fair and impartial grading system.						
10. Shows interest in student progress.						
11. Is enthusiastic in his teaching.						
12. Motivates students to think for themselves.						
13. Is readily available for consultation.						
14. Promotes an atmosphere of mutual respect.						
15. The overall performance of the teacher is . . .						
16.						
17.						
18.						
19.						
20.						

PLEASE USE THE REVERSE SIDE OF THIS SHEET FOR ANY WRITTEN COMMENTS YOU WISH TO MAKE.

[illegible] 9586

[illegible] Optical Scanning Corporation, [illegible]

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